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GROWTH IN AREA, PRODUCTION, AND PRODUCTIVITY OF *KHARIF* PADDY IN CHHATTISGARH

REENU SINGH[1], RAVINDRA BRAHME[2] & V. B. SINGH[3]

[1]*Research Scholar, School of Studies in Economics, Pt. Ravishankar Shukla University, Chhattisgarh, India*

[2]*Professor & Head, School of Studies in Economics, Pt. Ravishankar Shukla University, Chhattisgarh, India*

[3]*Professor & Head, Department of Statistics, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India*

ABSTRACT

The analysis of growth is usually used in economic studies to find out the trend of a particular variable over a period of time and used for making policy decisions. The present study initiates and analyzes the trends in area, production, and productivity of kharif paddy in Chhattisgarh state at district and agro-climatic zone levels, covering the most recent period from 2000-01 to 2015-16 by using mean, a coefficient of variation and compound growth rates. All the agro-climatic zones of Chhattisgarh (except Bastar plateau) and whole Chhattisgarh state recorded significant and positive growth rate in production and productivity of Kharif rice with 27.64 to 30.39 per cent fluctuation in production and with 26.89 to 29.89 per cent fluctuation in productivity. The growth rate in the area under kharif paddy was positive and statistically significant only in Chhattisgarh plains zone and in whole Chhattisgarh state while in case of northern hills zone, it was negative and significant. Most of the districts come under Chhattisgarh plains zone registered a positive and significant compound growth rates in the area, production, and productivity of kharif rice. The increase in production was mainly due to an increase in productivity of Kharif rice in the state. The predicted result shows an increase in area, production and productivity of Kharif rice in the state.

KEYWORDS: Kharif Paddy, Growth, Coefficient of Variation, Area, Production & Productivity

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INTRODUCTION

Agriculture plays a vital role in India`s economy. About 54.6 per cent of the population is engaged in agriculture and allied activities (census 2011) and it contributes 17 per cent to the country`s Gross Value Added (current price 2015-16, 2011-12 series). Among the paddy growing countries in the world, India occupies an important place in terms of total area under cultivation and total production but, as for as productivity and growth rate are observed it is not in the place of pride. The fast increasing population builds up the need for tapping the opportunities to increase the food production, particularly paddy. Total rice production in India increased from 53.6 million tonnes in 1980-81 to 105.5 million tonnes in the year 2014-15. Productivity also improved from 1336 kg/ha to 2391 kg/ha during 1980-2014. Nonetheless, the total area under paddy cultivation has not increased much; it was around 40 million hectares in 1980-81 and 44 million hectares in the year 2014-15. As per the FAO estimates the annual growth rates of area, production and yield were -0.17, 2.04 and 2.2, respectively. Nearly 85 per cent of the country's total paddy output is grown during the *kharif* season (between June and September) while the rest of the 15 per cent is cultivated during the Rabi season (between November and February). As per the land use statistics

2015-16, the total geographical area of the Chhattisgarh state is 13.79 million hectares, of which 5.64 million hectares is the gross cropped area with a cropping intensity of 121.3 per cent. The net sown area works out to be 33.73 per cent of the total geographical area. The net irrigated area is 1.476 million hectares. In Chhattisgarh, paddy, the main crop, is grown on about 77 per cent of the net sown area. Only about 20 per cent of the area is under irrigation, the rest depends on rain of the three agro-climatic zones, about 73 per cent of the Chhattisgarh plains, 97 per cent of the Bastar plateau and 95 per cent of the Northern hills are rainfed. During the period 2010-2014, Chhattisgarh's share in India's *Kharif* paddy cultivated area was from 9.45 to 9.96 per cent, whereas, its share in *Kharif* paddy production was between 6.50 to 8.30 per cent. In each year, the percentage of Chhattisgarh's share in production was lower than its proportionate share in the *kharif* paddy cultivated area. Furthermore, during this period, the productivity of *Kharif* rice in Chhattisgarh was ranged from 1589 to 1976 kg/ha which was lower than the *kharif* rice productivity in India (2120 to 2374 kg/ha). The present study initiates and analyzes the trends in growth rates in the area, production and productivity of *kharif* paddy of Chhattisgarh state at the agro-climatic zone and district level and may help to identify suggesting measures for increasing the production and productivity of *kharif* paddy.

METHODOLOGY

The analysis covers the time series secondary data with respect to area, production and productivity of kharif paddy for the period of 2000-01 to 2015-16. The data set was collected from several government publications and websites. Presently, Chhattisgarh consists 27 districts. The limitation of this study is that the data information in terms of the number of years for some districts like Baloda Bazar, Gariaband, Balod, Bemetara, Mungeli, Surajpur, Balrampur, Kondagaon, Sukma, Narayanpur, and Bijapur is less because of its new creation. These districts therefore, are merged in their parent districts. So effectively, the results of 16 districts are presented in the study. As per the agro-climatic zones, Chhattisgarh is divided into three agro-climatic zones namely. Northern hills zone, Chhattisgarh plains zone, and Bastar plateau zone. These zones have huge variations in terms of soil topography, rainfall intensity, and distribution, irrigation and adoption of the agricultural production system and thus vary in the productivity of rice in these regions. Out of 16 districts, Northern Hills zone consists of three districts –Koriya, Surguja, and Jashpur; Chhattisgarh plains zone consists of eleven districts – Kawardha, Bilaspur, Korba, Raigarh, Janjgir-Champa, Rajnandgaon, Durg, Raipur, Mahasamund, Dhamtari and Kanker and Bastar Plateau zone consists of two districts namely Jagdalpur (Bastar) and Dantewada.

The projection method was employed to estimate the trend from past data to obtain a forecast in area, production, and productivity of kharif rice in Chhattisgarh. The basic formulas for trend projection are given below:

$$Yt = b0 + b1t$$

Where,

Yt = trend forecast for the time t

b0 = trend line projection for time 0

b1 = slope of the trend line

Estimates of b0 and b1 were computed by Ordinary Least Squares (OLS) method.

The compound growth rates were computed by fitting the exponential function as below:

Yt=abt

Where,

Yt=dependent variable on the area, production and productivity in the year 't'; a=constant; b=regression coefficient;

t=time element which takes the value 1, 2, 3,…, n

After transforming the model into a linear form by taking logarithms, we get

log Yt=log a+t log b

By putting log Yt=y, log a=A and log b=B, the model becomes linear between y and t, as y=A+Bt, fit the model by the method of ordinary least squares (OLS) technique. The compound growth rate (r) in per cent was obtained by the following formula:

r=(b-1)×100= (antilog B-1)×100

The significance of growth rate was tested by applying Student 't' test statistic

t=r/S.E.(r)

Where S.E.(r)=100×b×S.E. (log b)/0.4343

Which follows 't' distribution with (n-2) degree of freedom, n is the number of years considered under study. The compound growth rates were computed for all the agro-climatic zones and their districts and the state as the whole.

The productivity (yield) was calculated by the following formula:

Productivity (Yield) = Total production/Total cultivated area

The mean (average) values were calculated by dividing the sum of Area/Production/Productivity for the number of years (16) taken for study.

The coefficient of variation (C.V.) was used as a measure of instability as:

C.V=(Standard deviation/Mean)×100

RESULTS AND DISCUSSIONS

Paddy is one of the important staple food crops grown in the state. In Chhattisgarh, paddy accounted for about 77 per cent of the total area under food grains and about 69 per cent of the total production of food grains during 2015-2016. The details of growth in the area, production, and productivity of *Kharif* rice in different agro-climatic zones and in whole Chhattisgarh area are presented in Table-1. The average area under *Kharif* paddy in the state during the study period (2000-01 to 2015-16) was 3777.13 thousand hectares. The fluctuation in the area under *kharif* paddy in the state appeared to be low as the coefficient of variation was 0.83 per cent. The growth in area under Kharif paddy in the state has recorded a very low but significant annual increment (0.15%). The growth in the *kharif* rice output in the state was positive and highly significant which was 4.66 per cent per annum with a fluctuation of 27.64 per cent. The state registered an annual increment of 4.50 per cent highly significant growth in the productivity of *kharif* rice.

Among agro-climatic zones, the highest average area under *Kharif* paddy cultivation was held by Chhattisgarh plains zone with 2759.73 thousand hectares which were 73.07 per cent of the total *kharif* paddy cultivated area in the state. The second highest average area under *Kharif* paddy cultivation was registered with northern hills zone (555.77 thousand ha) closely followed by Bastar plateau zone (461.63 thousand ha) which was 14.71 and 12.22 per cent of the area under *kharif* paddy in the state, respectively. The area under *Kharif* paddy in Chhattisgarh plains zone has witnessed a marginal but significant annual increment of 0.24 per cent, while the area under *kharif*paddy in northern hills and Bastar plateau zones has registered a negative growth of -0.11 (significantly at p=0.05) and -0.05 per cent per annum, respectively. The fluctuation in the area under *Kharif* paddy was 0.94 and 1.73 per cent in Northern hills and Bastar plateau zones, respectively.

In the production of *kharif* rice, Chhattisgarh plains zone's average production in the 16 years studied period was 3945.30 thousand tonnes which was highest among all the agro climatic zones and was 75.78 per cent of the total production in the state. The Chhattisgarh plains zone registered a significant increase in *Kharif* rice production (5.08% per annum). The fluctuation in the production of K*harif* rice under this zone was 28.24 per cent. In northern hills zone, *Kharif* rice production was increasing at 3.72 per cent per annum while in Bastar plateau zone, it was increased at the rate of 3.36 per cent per annum. The fluctuations in the production of *Kharif* rice in the northern hills and Bastar plateau zones were 28.81 and 30.39 per cent, respectively.

As far as the productivity of *Kharif* rice is concerned, Chhattisgarh plains zone's sixteen years average productivity of 1426.34 kg/ha was the highest of all the productivity values of the agro-climatic zones. The coefficients of variations in productivity were 26.89, 27.53 and 29.89 per cent respectively in northern hills, Chhattisgarh plains, and Bastar plateau zones. *Kharif* rice productivity recorded a significant increment of 4.83 per cent per annum in Chhattisgarh plains zone followed Northern hills zone (3.83% per annum) and Bastar plateau zone (3.41% per annum).

Table-2 shows the growth in the area, production, and productivity of *Kharif* rice in different districts of Chhattisgarh. The trend analysis indicates that against the overall production trend of 4.66 per cent, minor to medium *Kharif* paddy-growing districts like Janjgir-Champa, Mahasamund, Dhamtari, and Kanker showed growth rate of 8.32, 6.36, 5.48 and 5.30 per cent, respectively. Raipur, Durg, and Bilaspur, being the most important paddy cultivated districts, showed equal or quite high compound growth rate of production (4.66 to 5.10%) whereas, Kawardha, Raigarh, Jashpur, Surguja, and Dantewada have shown positive and significant but lower growth rate of production (3.46 to 4.38%) of *kharif* rice. Other districts like Rajnandgaon, Korba, Koriya, and Jagdalpur were also showed a positive but not significant growth rate of production of kharif rice. Table-2 reveals that the growth rate of *kharif* paddy area was highest and significantly positive in Kawardha (0.73%) followed by Rajnandgaon (0.66%) Kanker (0.54%), Dhamtari (0.53%), Durg (0.46%), Mahasamund (0.33%) and Bilaspur (0.26%) whereas it was negative and highly significant in Raigarh and Surguja districts. The rest of the districts showed very low and non-significant positive as well as negative compound growth rates.

The CGR of productivity of *Kharif* rice at the state level was 4.50 per cent, which was highly significant. Among the districts, the highest and significant CGR of 8.38 per cent for productivity was connected to Janjgir-Champa followed by Mahasamund, Dhamtari, Bilaspur, Kanker, Raipur, Dantewada, Surguja, Raigarh, Jashpur, and Kawardha with 6.01, 4.92, 4.83, 4.73, 4.64, 4.49, 4.19, 3.95, 3.71 and 2.78 percentages respectively. However, Durg, Korba, Jagdalpur, Rajnandgaon, and Koriya have also shown positive but non-significant CGR with 4.54, 2.83, 2.57, 2.15 and 2.12 percentages respectively.

The forgoing discussion reveals that the growth in production of *Kharif* rice in the state as well as in Chhattisgarh plains zone was largely attributable to the growth in productivity and was supplemented by area growth implying that the increase in production of Kharif rice was mainly due to the increase in its productivity rather than an increase in area. The significant growth in the production of *kharif* rice in the northern hills zone has come mainly from the growth in productivity. Similarly, the growth in the production of *kharif* rice at district level has come mainly from the growth in the *kharif* rice productivity. Acharya *et al.* (2012) and Syed and Meera (2012) also reported similar results in respect of production and productivity of rice.

Projection of *Kharif* rice area, production, and productivity for the years 2020-21, 2025-26 and 2030-31 was made on the basis of linear trend analysis based on 16 years' (2000-01 to 2015-16) data on these variables and are given in Table 3. The regression coefficients (b_1-values) for an area, production and productivity were 5.7321, 209.3706 and 53.45, whereas intercept (b_0) values for these variables were 3728.403, 3425.546 and 921.8198, respectively. As per the projected results, the area under *kharif* paddy in Chhattisgarh will reach 3848.78 thousand hectares in 2020-21, which is 3877.44 thousand hectares in 2025-26 and will increase to 3906.10 thousand hectares during 2030-31. Projected production on the other hand also shows upward movement. In the future, the *kharif* rice production will reach 7823.33 thousand tonnes in 2020-21, 8870.18 thousand tonnes in 2025-26 and will increase further to 9917.03 thousand tonnes during 2030-31. Like area and production, productivity has also shows an increasing trend. It will increase to 2044.27 kg/ha in 2020-21, 2311.52 kg/ha in 2025-26 and will reach 2578.77 kg/ha during 2030-31. This increased production and productivity will be achieved through the popularization of high yielding rice varieties and rice hybrids in larger areas and promotion of scientific rice farming through group approach in a participatory mode. The modernization of agriculture sector and rice farming has to be made move remunerative to attract more farmers for which measures to augment income from rice-based farming will be formulated.

CONCLUSIONS

Analysing the growth rate trends in the agricultural area, production and productivity over a period of time at national, state or district level has remained issues of significant concern for researches as well as policymakers. It has been argued that analysis of the growth rate trends helps us to identifying the changing pattern of crops and land use pattern under different crops and rate of change in the area, production and productivity of a crop and further help in designing the appropriate agricultural policy for a region or state. The growth rate in the area of *kharif*paddy was found positive and significant in Chhattisgarh plains zone due to the positive and significant growth rate in the area of *kharif* paddy in most of the districts of Chhattisgarh plains zone. A similar trend in respect of *kharif* paddy area was also seen in whole Chhattisgarh. CGR's of *kharif* paddy area in northern hills zone along with their most of the districts were significantly negative whereas, although, it was also negative in Bastar plateau zone but not found significant. The growth rate of production and productivity of *Kharif* rice was found positive in all the agro-climatic zones and their districts, but, it was not touching the level of significance in respect of Bastar plateau zone and some of the districts like Rajnandgaon, Korba, Koriya, and Jagdalpur. The growth in the production of *kharif* rice in the agro climatic zones and their districts and in the state has come mainly from the growth in the rice productivity than the growth in an area. The predicted result shows an increase in area, production and productivity of *Kharif* rice in Chhattisgarh. Even though Chhattisgarh has shown an increase in productivity in the sixteen year periods, the rate of growth in productivity is not up to the mark as compared to other states of India. There are many reasons for such low performance. Some of the reasons

behind this slow growth rate being the fall in public investment in agriculture, disparities in productivity across the different paddy growing zones within the state, conversion of agricultural lands to other purposes, withdrawal of input subsidies, disproportionate use of fertilizers, slower growth of area under high yielding varieties change in climatic conditions, frequent monsoon failures, crop failure due to damages caused by pest and diseases and ineffective transfer of technologies from Research stations/ Institutions to the farms cultivators. Thus, there is a need to take up productivity enhancing measures in *Kharif* paddy like the varietal improvement, improved cultural practices, pests and disease control measures, cultivation of high yielding varieties and irrigation facilities.

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APPENDICES

Table 1: Agro Climatic Zone-Wise Growth in Area, Production and Productivity of *Kharif* Paddy in Chhattisgarh (2000-01 to 2015-16)

Particulars	Northern Hills	Chhattisgarh Plains	Bastar Plateau	Total
Area				
Mean ('000' ha)	555.77 (14.71)	2759.73 (73.07)	461.63 (12.22)	3777.13 (100)
C.V. (%)	0.94	1.19	1.73	0.83
CGR (%)	-0.11*	0.24**	-0.05	0.15**
Production				
Mean ('000' M.T.)	658.65 (12.65)	3945.30 (75.78)	602.25 (11.57)	5206.20 (100)
C.V. (%)	28.81	28.24	30.39	27.64

Table 1: Contd.,				
CGR (%)	3.72*	5.08**	3.36	4.66**
Productivity				
Mean (kg/ha)	1185.26	1426.34	1303.41	1374.14
C.V. (%)	26.89	27.53	29.89	27.11
CGR (%)	3.83**	4.83**	3.41	4.50**

Note: Figures in parentheses represent percentages to the total,
*- denotes significant at 5 per cent
**- denotes significant at 1 per cent

Table 2: District–Wise Growth in Area, Production and Productivity of *Kharif* Paddy in Chhattisgarh (2000-01 to 2015-16)

District	Compound Growth Rate (%)		
	Area	Production	Productivity
Raipur	0.016	4.66*	4.64*
Mahasamund	0.33*	6.36**	6.01**
Dhamtari	0.53**	5.48**	4.92**
Durg	0.46**	5.03*	4.54
Rajnandgaon	0.66**	2.82	2.15
Kawardha	0.73**	3.53*	2.78*
Bilaspur	0.26*	5.10**	4.83**
Janjgir-Champa	-0.06	8.32**	8.38**
Korba	-0.05	2.78	2.83
Raigarh	-0.47**	3.46*	3.95*
Jashpur	0.03	3.74*	3.71*
Surguja	-0.19**	3.99*	4.19**
Koriya	-0.06	2.05	2.12
Jagdalpur (Bastar)	-0.009	2.56	2.57
Dantewada	-0.10	4.38*	4.49*
Kanker	0.54**	5.30*	4.73*
Total Chhattisgarh	0.15**	4.66**	4.50**

Note: *- denotes significant at 5 per cent
**- denotes significant at 1 per cent

Table 3: Projected Area, Production and Productivity of *Kharif* Rice in Chhattisgarh

Year	Area ('000' ha)	Production ('000' tones)	Productivity (kg/ha)
2020-21	3848.78	7823.33	2044.27
2025-26	3877.44	8870.18	2311.52
2030-31	3906.10	9917.03	2578.77